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TRAUMATIC ASPHYXIA.

REPORT OF A RECENT CASE, WITH A STUDY OF THE MINUTE PATHOLOGY, AND
SUMMARY OF REPORTED CASES.

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THE writers desire to report the following case, not only because of its great rarity, but because it is the only case in which microscopic study of sections of skin taken from the living has been made, and by this study all doubt as to the minute pathology and cause of the discoloration cleared away. The mechanism of the remarkable condition is expressed by the term traumatic asphyxia or apnoea; the striking discoloration follows forcible compression of the thorax so that breathing cannot take place for several minutes. The number of cases that have recovered, cases which have been studied in life, is very small. It has been possible to find in all literature but

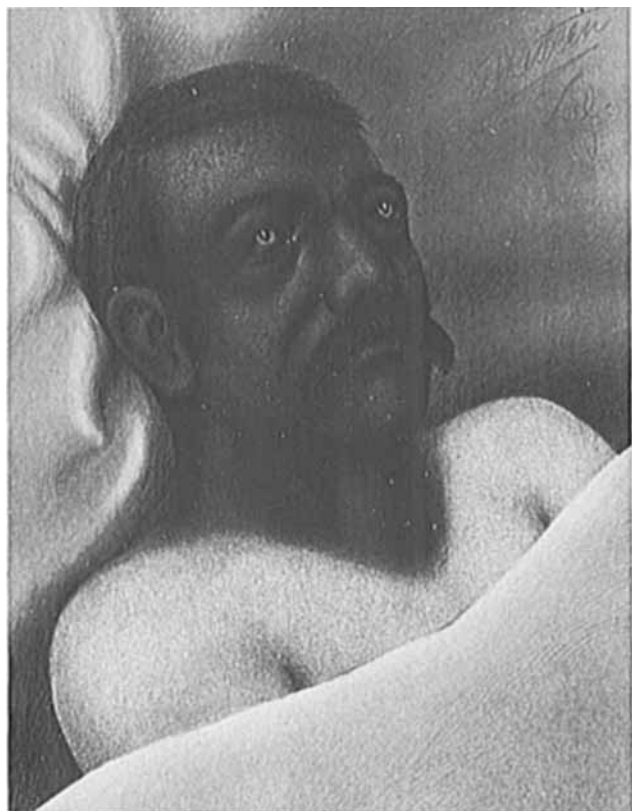
six cases,—one case reported by Burrell and Crandon, of Boston, the other five reported by German observers.

The report of the writers' case is as follows:

The patient entered the West Surgical Service of the Massachusetts General Hospital on January 2, 1902. He was a large, muscular German, thirty years old, by occupation a grocer, and was said to have been in perfect physical health up to the time of the accident. About an hour before, he had been caught and held by a moving freight elevator. The elevator was stopped and the man released in from three to five minutes. It was related by observers that while being released his face became black and blood ran from his nose and mouth, and that his eyes protruded. He was unconscious for a few minutes after being released.

Examination in the accident room in the hospital, approximately one hour after he was injured, was as follows: Especially well-developed and nourished; perfectly conscious, but dull and sluggish; in a state of moderate shock; temperature 99.5° F. It was apparent from physical signs that he had been subjected to violent trauma from the groins and buttocks to the midthoracic region; over the skin of the abdomen were several contusions; in the left loin and back, low down towards the pelvis, was a large fluctuating hæmatoma; the eighth and ninth ribs on the left side were fractured in the midaxillary line; in the neighborhood of the fractured ribs, for a short distance, was a moderate amount of subcutaneous emphysema. Examination of the heart and lungs was negative. The appearance of the face and eyes was as is shown in the picture. (See chromolithograph.) Pressure on the blue-black skin did not cause it to pale completely as in cyanosis, but, on the contrary, had little effect.

On careful inspection the skin of the face seemed to be dotted with countless spots, from black and reddish-black to blue in color, very close together, while between the spots were lines or areas, very minute, of normal appearing skin. These spots were plainest at the line of the hair on the forehead and close to the normal skin on the neck. The artist has well shown the punctate nature of the coloring. The line of demarcation in the neck in front was sharp, the transverse line running through the inner ends of each clavicle; this can be seen in the picture. What is not shown in the picture, and has not been noted in any other case, is that the





double triangle of the trapezius muscle was marked out very clearly; that is to say, that at the back of the neck there was none of the bluish-black discoloration of the skin except within the confines of this muscle. The ophthalmoscopic examination of the retinae showed no hæmorrhages. (In this connection, it is to be noted that Burrell's case showed retinal hæmorrhages; in Braun's case, however, there were none.) The conjunctivæ bulged forward prominently because of extensive hæmorrhages underneath. The pupils were equal and reacted to light. Urine examination showed nothing abnormal. The patient recovered. At no time was he very sick, except on the third day his temperature rose to 106° F., and he had labored breathing and slight bloody expectoration, and both lungs were full of râles; this condition, however, passed away in twenty-four hours. The hæmatoma in the back was aspirated six times; each time from one to two pints of bloody serum were withdrawn, but this re-accumulated with great rapidity, so that at last free incision and packing with gauze were necessary, after which the condition was relieved; the serum was at all times sterile.

On the second day after entrance, while the discoloration was still in its greatest intensity and had not visibly faded, with the consent of the patient, pieces of skin were removed from the discolored area in the neck for microscopic examination, with a view of throwing some light on the much disputed question of the etiology and minute pathology of this rare condition. So far as we can ascertain, this is the only case in which it has been possible to study sections of the skin obtained from a living patient, and, as will be discussed later in this article, it seems to the writers that the study in this case has definitely settled much of what was previously doubtful as to the pathology.

The discoloration disappeared rapidly after the third day, apparently simply fading out; the areas of normal skin between the punctate color spots became larger and wider; the general color scheme turned from black to lead color, to a slightly cloudy appearance of the skin, and three weeks afterwards the patient's face seemed almost normal, having only a slightly suffused appearance. In contrast to the fading away of the color in the face, the subconjunctival discoloration went through the usual chemotactic changes seen in the absorption of any blood-clot. In the face there were no pigmentary changes, in the eyes these were present. All

the functions of the body were performed normally during convalescence.

The gross cause of this unusual clinical picture is admitted to be forcible compression of the chest, extending over some minutes, accompanied by entire cessation of respiration. Knowledge of the pathology has hitherto been obtained from post-mortem findings in fatal cases. It has long been noted that this peculiar discoloration of the face was seen not infrequently in individuals pressed to death in struggling crowds or mobs. Ollivier, Tardieu, and others have reported post-mortem findings in such cases, but, aside from the appearance of the face and eyes, no specially characteristic pathological lesions were found. In all cases it was noted that the blood was black, fluid, and filled all the veins running into the heart; that punctate hæmorrhages occurred into the loose tissues of the scalp, on the surfaces of the pleuræ and pericardium, and the heart and abdominal viscera; that is to say, the usual findings in fatal cases of suffocation from whatever cause.

The minute cause of the discoloration has been the subject of greatest interest; this, as well as the reasons for its sharp limitations, has not been definitely determined. In view of the great rarity of the condition in the living, the writers desire to give a *résumé* of reported cases, together with the important conclusions in the light of their own case.

Summary of Cases.—Braun reports one case of his own and gives two other cases, one reported by Hueter, the other by Vogt. Willers, in an inaugural dissertation, discussed these last two cases. It will be remarked in the reports of certain of the following cases that the words hæmorrhages, petechiæ, ecchymoses, extravasations, and effusions are used by those reporting the cases to describe the general cause of the discoloration as well as its punctate appearance. This use of words is manifestly inaccurate in the light of the microscopic finding in the writers' case.

CASE I.—Braun, H. (*Ueber ausgedehnte Blutextravasate am Kopfe, Halse, Nacken und linken Arm infolge von Compres-*

sion des Unterleibes.) *Deutsch. Zeit. f. Chir.*, 1899, Band li, p. 599.

February 26, 1878. G. K., twenty years old, was crushed by falling masonry, his chest and abdomen being compressed for half an hour. His head and neck were not struck.

Physical Examination.—Face: no lesion of skin, which was of a dark blue color, especially on the left side. The bulbi appeared very prominent; in both conjunctivæ, corresponding to the aperture of the lids, there were marked bloody extravasations, and both pupils were dilated and did not react to light. There were a great many ecchymoses, from a pin-head to a pea in size, on the face, neck, and left upper forearm. Patient did not complain of pain in chest, but of great pain in abdomen; although there were no wounds of the skin or of the internal organs found, nor any symptoms which might point to such. He was conscious during the accident and on entrance to the hospital. Pulse and temperature normal. On the evening of the same day the ecchymoses of the skin were more marked than in the morning, and the pupils were still dilated, but reacted slowly to light. Urine was not passed during the day, but was drawn by catheter at night. It was clear, acid, no trace of blood, not even on microscopic examination, but there was present a marked trace of albumen.

The next day the swelling of the face had gone, but the small punctiform hæmorrhages were still marked. The pupils reacted normally. Examination of the retinæ showed no changes nor any extravasation of blood. Pulse and temperature normal.

Since the patient felt wholly well, and the swelling of the face had gone, and only ecchymoses of the skin and conjunctivæ were present, he was discharged on the fourth day. Seen again several months later. He was well.

(It is to be noted that this case had no severe symptoms; that the compression lasted half an hour; that he was discharged from the hospital while his face was still discolored.)

CASE II.—Hueter. A boy, fourteen years old, was caught by the flail of a threshing-machine over the abdomen. He had a penetrating wound in the abdominal wall, from which the intestines protruded, and were put back by Hueter. The wound healed without event in four weeks. He was not unconscious at the time and there was no injury to the head. His face was dark blue in color and covered with petechiæ the size of a pin-head and slightly

larger, with irregular notched edges. This condition was found over the whole face, extending upward to the hair, while the lower boundary ended on a line with the thyroid cartilage. The conjunctivæ contained blood, and also the nasal mucous membrane. There was marked epistaxis. After twenty-four hours the face was no longer blue, but arterial hyperæmia was present, which lasted three days. After this these small blood extravasations ran a normal course, and on discharge only the remains of the subconjunctival hæmorrhage were present.

CASE III.—Vogt. In 1871 Vogt was called to see a boy fifteen years old whom he found lying on a soft sandy road, the wheel of a heavily loaded wagon having passed over his abdomen. He was apparently unconscious and was taken to a house. A contusion of the abdominal wall was found, not very severe. The face was blue and contained small extravasations of blood under the skin, as if they were sown seed. The extent of this was the same as in the case of Hueter. There was no injury to the head. All discoloration was gone in three weeks.

CASE IV.—Perthes, G. (*Ueber ausgedehnte Blutextravasate am Kopfe infolge von Compression des Thorax.*) *Deutsch. Zeit. f. Chir.*, 1898-99, Band I, p. 436.

On July 15, 1898, a boy fourteen years old was working in a cotton mill as a spinner, when, according to eye-witnesses, he was struck by a machine-driven carriage. He was struck on the right side of the chest, and so pressed, with his left shoulder against a bench, that his thorax was crushed into a two hands'-breadth space, but his head remained free. The boy was rescued in an unconscious condition, but while in the factory regained consciousness. He himself said positively that during the first hour after the injury he heard all that happened around him, but could not see. He was unable to recognize his brother, who accompanied him to the hospital.

We found, an hour after the injury, a very small boy for his age, weak and poorly nourished, conscious. The pulse was regular, strong, and 86 per minute. The boy's face was of a blue color, only the lower half of the right cheek being somewhat paler. The dark color did not disappear on pressure, but through it were easily seen countless dark red petechiæ. Similar petechiæ were seen on the upper half of the left side of the neck, and the lids of both eyes were very deeply colored a bluish-red. There was a

slight degree of exophthalmos. The conjunctivæ were completely suffused with blood and the sclera of each eye colored blue-red. No trace of any wound of the head could be found. There was no bleeding from the nose and ears. No paralysis of the nerves of the face and the pupils reacted to light promptly. There was, however, marked swelling of the tissues of the head, which was greater in the temporal regions, and because of which the whole shape of the head seemed changed.

There was a fracture of the left clavicle at the junction of the middle and outer thirds with typical dislocation. Over the third and fourth ribs on the right side of the midaxillary line there were circumscribed tenderness on pressure and crepitation. Breathing was frequent and catchy, but examination of the lungs showed nothing abnormal, especially no hæmothorax. There was no hæmoptysis.

During the course of his illness, the only thing noteworthy was a slight rise in the temperature to 38.3° C. without any perceptible cause. From this time on the temperature remained at 37.3° C. The pulse-rate varied from 76 to 96. The absorption of the extravasated blood followed quickly. After four days the dark color of the skin had partly gone, only several petechiæ remaining visible about the eyes, which were still a dark bluish-red.

On discharge, on the 8th of August, the fractures had healed without deformity. The subcutaneous blood extravasations had been absorbed, but the ecchymoses under the subconjunctivæ remained six weeks after the injury.

(Not so extensive, but otherwise similar, with blue extravasations, is the second case reported by Perthes.)

CASE V.—A teamster, thirty-six years old, was caught between a part of an overturned wagon and an iron post so that his thorax was compressed anteroposteriorly; his head was not struck, but his left arm was caught underneath the wagon. Immediately he could not get his breath, and felt as if his eyes were starting out of his head. He retained full consciousness, heard clearly words spoken around him, but could not see.

Examination showed a strong man, conscious, but much excited. The pulse was small and rapid, breath very shallow and quickened. He complained of pain in the lower posterior part of the thorax with each inspiration. The whole face had a swollen appearance, especially in the temporal regions, and was of a bluish-

red color. This was especially noticeable in the lower eyelids and thereabouts. The scleral portions of both eyes were colored red with blood, as were also the palpebral conjunctivæ. At the upper part of the neck were several small bluish-red spots. Neither in the head nor thorax could any wound be found, not even posteriorly, where the patient complained of pain. There was no hæmoptysis. In the left forearm there was a fracture of the radius in the middle, complicated with extensive crushing of the skin and muscles on the outside.

He was chloroformed, the radius was wired, and the wound drained. On the third day there was a rise in temperature to 38.9° C. Behind, on the left side of the thorax, where the patient had complained of pain, were found dulness and râles on auscultation. There was marked bloody sputum. A diagnosis was made of "contusion-pneumonia." The rise in temperature lasted but four days, and on the tenth day following the accident all pneumonic symptoms had gone. The bluish-red color of the face had wholly gone in four days, with the exception of that about the eyes. On the thirtieth day there were still a few traces of the subconjunctival hæmorrhages. There was no disturbance of vision.

Perthes discusses his cases as follows, his own use of words is retained: The two patients during the first two days appeared to be exactly similar. Their faces had a dark-blue coloring, which did not disappear on pressure, but on close observation one could see under this bluish-red coloring still deeper specks caused by the entrance of blood into the skin. These petechiæ were also seen to extend to the upper part of the neck. The coloring of the face was so striking that the second patient was addressed as "The Nigger" by his companions in the hospital. The color in both cases was due not only to ecchymoses, but also to hæmorrhages into the subcutaneous tissue. In both cases the eyelids and their immediate neighborhood were the seat of the most marked effusion. The peculiar appearance which both our patients had was mainly caused by the deep red color of the scleræ, due to hæmorrhage under the conjunctivæ, no white remaining. The patients said that they had immediately lost sight. Possibly this was caused

by a venous hyperæmia and œdema of the retina, or perhaps by compression of the optic nerve by retrobulbar effusion of blood. The intracutaneous effusion of blood in the face disappeared very quickly in both cases, on the fifth day only traces of it could be seen. The effusion in the lower lids lasted much longer, and the subconjunctival hæmorrhage lasted from five to six weeks.

CASE VI.—Burrell, H. L., and Crandon, L. G. R. (*Boston Medical and Surgical Journal*, January 2, 1902, p. 13.)

"E. F., twenty-two years old, single, was brought to the Boston City Hospital on December 7, 1900, having sustained a crushing injury to the chest. The detailed history is as follows: One hour before admission, the patient, in a standing position, had been caught between an electric car and the door-post at the entrance to the car-house. His chest had been compressed antero-posteriorly; the head and pelvis were not caught. He was held as in a vise fully three minutes before the car was moved, he then fell unconscious.

"Physical examination on the accident table showed a large, muscular man with especially well-developed thorax. He was entirely unconscious; pulse 100, weak but regular; respiration 30, shallow, with a groan at the beginning of each expiration. The hands and nose were cold. There was slight bleeding from both ears and both nostrils, and blood in the mouth; no wounds on the head; pupils small, equal, and did not react; excessive chemosis. Knee-jerks were absent, other reflexes present, but diminished.

"In the region of the left lower ribs anteriorly, about the seventh, eighth, and ninth, near the nipple line, was an undetermined fracture of one or more ribs, undetermined with exactness because of a considerable area of subcutaneous emphysema. This air under the skin extended over the whole left front chest and made palpation and auscultation of this area of little value. There was slight general abdominal spasm, but no unusual dulness, nor was there any vomiting.

"The striking feature of the case, however, was the condition of the man's skin. From the level of the third ribs, upward over the neck and face and into the scalp, the skin presented a

dusky, bluish, mottled appearance. This color became only slightly paler if pressed with the finger, and when the pressure was removed it slowly regained its former tint. At first it was thought that the patient was cyanotic, but, as the color was not universal over the body, and as it did not disappear on pressing the skin, and as it persisted even after the patient's general condition improved, it was evident that cyanosis was not the cause. Examined more closely it could be seen that uniformly distributed all over the dusky skin were minute (.5 to 1 millimetre) areas of natural skin-tint, each surrounded by a poorly defined bluish border, these borders uniting in a meshwork. This condition extended over the red edge of the lips and on the mucous membrane of the mouth to a slight degree. In the eyes there was a considerable subconjunctival hæmorrhage, homogeneously distributed over as much of the sclera as is exposed by the open lids and not extending to the parts covered by the lids. There were minute retinal hæmorrhages.

"The patient was in a condition of extreme shock, and stimulation to the extent of nitroglycerin $\frac{1}{26}$ gr., atropine $\frac{1}{60}$ gr., and strychnine $\frac{1}{16}$ gr., was given subcutaneously, with ice-cap to head and heaters to body. At the end of four hours consciousness returned, and there was considerable improvement in the character of the respiration and pulse. About the chest was applied a broken-rib corset, so laced as to limit respiratory movements near the injured part of the chest.

"The urine on the day of the injury was dark red, acid, specific gravity 1028, with a large trace of albumen and less blood, and in a few days was normal.

"After three days the patient was relatively comfortable; respirations were 30; pulse 80, good volume and tension; sensorium clear; vision slightly blurred. The dusky, livid appearance of the skin of the face and neck was unchanged. Five days later, eight after the accident, the blue color began to fade; the tint, however, remaining as at first and not going through the usual modifications of a cutaneous hæmorrhage. The subconjunctival clot persisted and had not gravitated, as is usual, to the inferior angle of the conjunctiva. Eleven days after the injury the unnatural color of the skin was practically gone and the eyes had begun to clear. After three weeks the patient got up, and in a few days was discharged practically well."

The dominant and diagnostic feature of these cases has been the blue-black discoloration of the skin, mainly confined to the face and neck above the clavicle; in one the discoloration extended into the forearm for some distance, and in the other it extended over the chest wall to the second or third ribs. The question of special interest is the cause of the discoloration and the reason for its limitation practically to the regions of the face and neck. Is the discoloration caused by hæmorrhages into the subcutaneous tissues, or by venous stasis? Although the writers feel that in the light of their own case there can be no doubt in regard to this, yet, for the sake of completeness and interest, they give briefly the experimental work and the conclusions of the men who reported cases previously.

The work and conclusions of Hueter are reported by Braun (*loc. cit.*). Hueter experimented on a rabbit. He made marked and continued abdominal pressure, or struck the abdomen a sharp blow. The vessels in the ear dilated and the surface of the brain protruded through a trephine hole, but there was no extravasation of blood. After section of the splanchni in frogs, he obtained dilatation of the vessels under the skin, but no extravasation. Hueter concludes that the discoloration is probably due to stasis of blood from mechanical causes,—1. The sudden upward pressure of blood dilates the vessels of the face; 2. Pressure on the sympathetic nerves of the abdomen and thorax leads to a paralysis of the vessel walls.

Willers concludes that it is not determined whether it is due to stasis or hæmorrhage, but he prefers the mechanical theory of Hueter; that the blood is found only in the face he thinks is due to the lack of valves in the facial veins. He also thinks that these cases are oftener seen in the young, who have more numerous skin capillaries than the old, in whom, besides being less in number, they are less elastic, and in whom such injury most often results in death.

(It is to be remarked that the ages of the cases, including the writers', are as follows: three cases were boys about fifteen years of age, all the others were young adults between twenty-two and thirty-six years old.)

As has been seen in his remarks above, Perthes is of the opinion that the cause of the discoloration is extravasation of blood, either minute or more extensive subcutaneous effusions, or hæmorrhages. He concludes that, following severe contusions with compression of the thorax, marked effusion of blood can occur in the head and its neighboring tissues without there having been any injury to the head itself. This is caused by the transmission of the increased intrathoracic pressure into the veins of the head and neck; its limitation to this area he explains by the absence of functioning valves, there being less competent valves in the jugular veins than in any others on the surface of the body. He states that there are no valves throughout the whole course of the internal jugular and innominate veins except a pair of valves at the entrance of the jugular into the innominate, and that it is well known that these valves are irregular and incapable of resisting the back pressure of an injection mass starting at the vena cava. The same is true of the external jugular. This vein possesses usually two inefficient pairs of valves, the first of which is the most constant and is placed where the vein enters the subclavian. The second pair is midway up the neck (Poirier: "Traité d'anatomie humaine"). These valves are no hinderance to the backward transmission of pressure into the veins of the head; and this also explains the limitation of the hæmorrhages to this region, since one can easily inject the veins of the head from the cava, but almost never those of the axillary supply, so we find ecchymoses and effusions of blood only where valves are absent or insufficient. As in these traumatic cases, the same series of events occur in a less marked degree in old people where ecchymoses or epistaxis follow severe coughing. So also in whooping-cough, a transient blindness or amblyopia has been seen.

Burrell and Crandon (*loc. cit.*) conclude that, while there may be true hæmorrhage into the skin, the facts that the color fades somewhat on pressure, and that the color does not go through the changes of tint usual in an absorbing hæmorrhage, favor the idea that the discoloration is due largely to a stasis of



FIG. 1.—Vertical section from the surface (low power), showing normal skin with pigment-bearing cells.

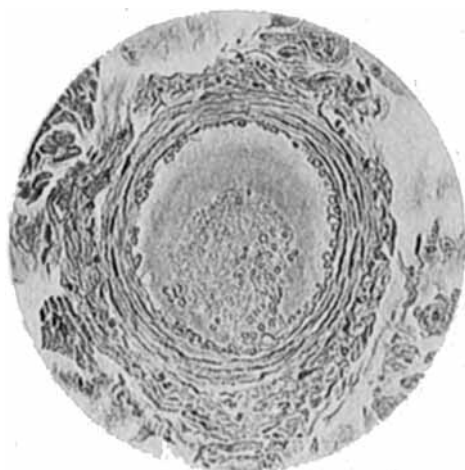


FIG. 2.—Section through small blood-vessel and neighborhood (high power). It is to be noted that no red blood-cells lie outside the lumen of the vessel.



carbonized blood in temporarily paralyzed and dilated capillaries.

The writers inclined from the first to the belief that there were no hæmorrhages of any size whatever into the skin, and that the discoloration was due to a stasis from mechanical overdistention of the veins and capillaries with or without paralysis from engorgement of or pressure on sympathetic nerves, but to determine this positively excised two pieces of skin from the neck under cocaine anæsthesia from an area as dark in color as any other. These pieces of skin were given to Dr. Wright, Pathologist to the Massachusetts General Hospital, and from them numerous microscopic sections were cut and examined. Every section studied showed normal skin; there were no signs of blood in the tissues outside of the blood-vessels. The accompanying cuts (Figs. 1 and 2) have been made from drawings of two sections.

It seems to the writers that this microscopic study proves definitely that the theories, that the discoloration is due, to any extent, to hæmorrhages, are wrong.

As to the cause of the sharp limitation of the color to the head and neck, the writers have nothing new to offer, but are inclined to consider rational the theory of Perthes, which ascribes it to the lack of valves in the jugular and facial veins, as outlined above.

The practical conclusions to be drawn from these cases are few in number and should be sufficiently obvious. It is idle to speculate on how many of the fatal cases might have recovered, as the above-mentioned cases did, could artificial respiration have been begun immediately after the release of the individual from the compression. From the very nature of the injury and its attending circumstances, surgical aid can rarely be on the spot except as a coincidence. It is rational to suppose, however, that the immediate use of artificial respiration and oxygen might resuscitate certain of such cases could it be applied at once; the cases that live without such aid will always be extraordinarily rare.

The secondary treatment, aside from combating shock,

must be symptomatic. On the second or third day in certain cases pulmonary complications, with pyrexia, bloody expectoration, and labored breathing, may appear; this condition Perthes called a "contusion-pneumonia;" it may be expected to subside rapidly and not to result fatally.

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